

extended source throws the shadow of a small object on a screen, under such conditions that the umbra of the shadow is not formed, then the shadow is the negative inverted image of the source of light.

Another shadow phenomenon observed during the partial eclipse may be mentioned here, although its explanation is obvious. In cases where the leaves of trees were so far advanced that most of the sun's rays were intercepted by them, the rays which passed through the small apertures between the leaves formed on the ground positive inverted images of the visible part of the sun's disc. The oval patches of light seen on the ground beneath thick trees under ordinary conditions of sunlight are due to the same cause. During the eclipse, the rays of the sun reflected from the free surface of water in a small glass formed a positive inverted image of the visible crescent of the sun on the walls or ceiling of the room in which the glass was placed.

EDWIN EDSER.

### Halo during the Solar Eclipse of April 17.

AS NATURE contains no mention of the circular halo that appeared for about half an hour during the solar eclipse on April 17, the following facts may be of interest, for possibly the appearance was very local.

I was in the south of the Isle of Wight, at sea-level, and noticed, just as the air began perceptibly to cool, that a faint and very gauzy film of cloud collected round the sun. This was transparent enough for the sun to appear through it unmasked, but just dense enough somewhat to relieve the glare and make it possible to take hasty glances at the sun itself with the naked eye. After the clouds drifted into position, they remained through the whole time of the eclipse, but disappeared when the sun's warmth returned. Shortly after their accumulation I saw a perfectly circular halo; this was coloured, but the bands of colour were only red, yellow, and greenish. The halo gradually increased in apparent diameter until it faded, as the eclipse waned.

MARIE C. STOPES.

University College, London, April 27.

### The Smoke Problem.

UNDER this head an anonymous notice appeared in NATURE of April 11 of a little volume by Mr. Ruston and myself, in which the reviewer refers to certain "weaknesses in what is otherwise so excellent a work." As the "weaknesses" form the bulk of the review, I have permission to try to explain them.

The first "weakness" is in reference to the origin of soot, which we ascribe partly to mechanical removal of dust and partly to incomplete combustion. The reviewer denies that coal-dust is a product of incomplete combustion, and also that tar and free carbon are formed in the destructive distillation of coal. I had imagined that tar and coke were among the principal by-products of the gas industry.

The next criticism occurs in the paragraph that follows, and refers to the amount of tar (we call "tar" the oil extracted by ether from soot and coal) in the original coals. The reviewer concludes, after citing some of our analyses, "surely the authors do not believe that a ton of these coals contains about a couple of gallons of ready-made tar." But suppose the authors have the weakness to accept the results of their analyses, what then? The reviewer offers no suggestion.

In the next paragraph the reviewer finds fault with the statement: "The chimney gases were drawn off at the rate of about a litre a minute (i.e. through a

narrow brass tube), which would approach the speed of the gases passing up the flue." Although he is good enough to interpret the passage for us in the only way in which it could possibly be interpreted, he concludes with the remarkable *non sequitur* that "if the flue draught was a litre a minute, it is no wonder their figures are abnormal." Of course, there is no such suggestion that the flue draught was a litre a minute (which has no meaning; unless the area of the flue is known), nor is it so stated. Having made this gratuitous assumption, on what grounds does he conclude that our figures are abnormal? What are the normal figures? I believe that the figures of the late Sir W. Roberts-Austen and our own are the only records of the kind, and they substantially agree.

In the next paragraph, among other remarkable items of information, is the statement that "the percentage of soot to carbon burnt is of no practical importance. It is the percentage loss on the fuel used that is the important factor." The reviewer apparently fails to see that (1) the entire object of the experiments was to ascertain the amount of soot emitted, and (2) the percentage of soot on carbon burnt can be easily calculated on the fuel used if the amount of carbon in the fuel is known (as it was in every case).

I do not wish to extend this reply by referring to our other "weaknesses," which are of the same gross order. I can only thank the editor for his courtesy in giving me his permission to show how and where some of them, at least, may have had their origin.

J. B. COHEN.

IN the above remarks by Prof. J. B. Cohen on the review of "Smoke: a Study of Town Air," which appeared in NATURE of April 11, the reviewer is first taken to task for denying that "coal-dust is a product of incomplete combustion, and also that tar and free carbon are formed in the destructive distillation of coal." The passage in the review was: "Dust is not, as a rule, a product of incomplete combustion, nor is the tar and free carbon formed in the destructive distillation of coal." The reviewer is still of opinion that coal-dust is not a product of incomplete combustion; by a strong chimney draught some coal-dust may be drawn up the flue, but it has certainly not been produced by combustion (unless Prof. Cohen looks upon the natural formation of coal as a process of incomplete combustion). Prof. Cohen elects to read the second part of the sentence as a denial that tar and coke are formed during gas manufacture, but it is doubtful if anyone else will do so; the reviewer's statement is that the tar and free carbon formed in the destructive distillation of coal are not products of incomplete combustion.

The authors give analyses of the original coal used in some of their experiments, and amongst the constituents of the coal figure certain percentages of tar, in one case amounting to 1.64 per cent.; and the reviewer says: "Surely the authors do not believe that a ton of these coals contains about a couple of gallons of ready-made tar." To this Prof. Cohen replies: "But suppose the authors have the weakness to accept the results of their analyses, what then? The reviewer offers no suggestion." If the authors do believe it, I am afraid they would take any suggestion the reviewer could make as an impertinence.

In replying to the criticism with regard to the rate of flow of the chimney gases in the flue, Prof. Cohen quotes from the book, and inserts five words which make the meaning clear, but which were not in the original paragraph.

Prof. Cohen claims that his figures for soot formation agree substantially with those obtained by the late Sir W. Roberts-Austen; but do they? Sir W. Roberts-Austen's figure was 6 per cent. of soot on the coal burned, whilst Prof. Cohen's figure is 6.5 per cent. of soot on the carbon burnt to carbon dioxide—carbon dioxide being the product of complete combustion, whilst soot has been defined by the authors as a product of incomplete combustion.

As pointed out in the review, no such method as that employed by the authors can give even approximately accurate results unless the carbon escaping as carbon monoxide and hydrocarbons is also estimated; and when Prof. Cohen says that the reviewer fails to see that the percentage of soot on carbon burnt can be easily calculated on the fuel used if the amounts of carbon in the fuel and carbon dioxide in the flue gases are known, he is truly stating the case.

In conclusion, I can only say that my opinion of the book is unchanged by Prof. Cohen's reply, and that it is a pity that so excellent a work has been marred by the points to which attention was directed in the review.

THE REVIEWER.

#### Remains of Prehistoric Horse in the Stort Basin.

WITHIN the last few weeks a metatarsal and an astragalus identical in type with those previously found at Bishop's Stortford (see Report B.A., Portsmouth meeting, 1911, p. 521) have been exhumed from beneath 3 ft. of native peat and 2 ft. of an overlying pond-silt of probably outwash from the Boulder Clay capping of the Essex Plateau. The site is about 300 ft. O.D. at Pledgdon Hall Farm, in the parish of Henham, on the left bank of the brook which flows through Stansted Mountfichet into the Stort. I am contemplating further excavation, with the kind permission of Sir Walter Gilbey, the proprietor. I may say that the shallow cutting for the new light railway to Thaxted makes the stratigraphy of the high ground to the north of this minor upland valley quite clear; and there again we have evidence of the "rubble-drift" movement on the hill-slope, of which I have already recorded a good number of examples in the Stort Valley. I reserve details until the excavation has been carried further.

Meanwhile, it may be interesting to note here the exhumation of a fairly complete skeleton of probably a mediæval ox (a "stray," perhaps, of the time of the ancient Essex "forest-laws"). The characteristic structural features of the skull rank it very closely with the type furnished by the remains of *Bos* from Newstead, as described by Prof. J. C. Ewart, F.R.S. ("On Skulls of Oxen from the Roman Military Station at Newstead, Melrose," Proceedings of the Zoological Society of London, 1911, text-figure 74), while the lower jaw and its dentition present us with but a slight modification of those of the *Bos primigenius* of the glacial shingle of the Stort Valley, at the same time differing strongly from those of *B. longifrons* (see B.A. Report, *loc. cit.*). This Essex ox-skeleton was cut through by Mr. H. G. Featherby, of Bishop's Stortford, in sinking an iron cylinder on the site of a spring for water supply to the farm. It was found in what is probably interglacial gravelly sand, and beneath some 3 ft. of *remanié* boulder clay stuff, which had worked down ("rubble-drift" again) from the Boulder Clay capping of the plateau above. It was evidently one of a number of landslides, which have furrowed the sloping meadows on both sides of the brook at Collier Street Farm, on the Barrington Hall Estate, in the parish of Hatfield Broad Oak.

Bishop's Stortford, April 27.

A. IRVING.

NO. 2218, VOL. 89]

#### An Anode Dark Space in the Discharge in Oxygen.

IT may be of interest to readers of NATURE to know that I have recently obtained unmistakable evidence of an anode dark space in the discharge in oxygen at low pressures. The anode which exhibited this remarkable phenomenon was an aluminium plate which had been used as an anode during an extended series of measurements of the Crookes dark space with kathodes of different metals. As these were continued for some months, and as the phenomenon was not noticed when the anode was fresh, one is inclined to connect the occurrence with the excessive fatigue of the metal surface.

The anode dark space is a region of comparative darkness just in front of the anode, and can only be seen when the latter is immersed in the bright negative glow. Its thickness is small, but as its edge is exceedingly sharp, it can be measured with fair accuracy. The rough values already obtained are very interesting, as they show it to be entirely unaffected by changes of pressure and to vary inversely as the square root of the current density; with the latter at one-tenth of a milliampere per sq. cm., its value is about 1.2 mm. in pure oxygen.

The same anode showed it, though faintly, in air and nitrogen, but no trace of it could be observed in hydrogen.

F. W. ASTON.

Cavendish Laboratory, Cambridge, April 25.

#### May Meteor-showers.

THE following meteor-showers become due during the period May 1-24, their arrangement being according to the times of the principal maxima:—

Epoch May 3, oh. 30m. (G.M.T.), approximately tenth order of magnitude. Principal maximum, May 3, 22h. 50m.; secondary maxima, May 3, 18h. 50m., and May 5, 19h. 40m.

Epoch May 4, 5h., third order of magnitude. Principal maximum, May 4, 5h. 10m.; secondary maximum, May 4, 17h. 50m.

Epoch May 8, 11h., twelfth order of magnitude. Principal maxima, May 5, 13h. 25m., and May 7, 10h. 10m.; secondary maximum, May 7, 12h. 20m.

Epoch May 8, 14h. 30m., approximately fifteenth order of magnitude. Principal maximum, May 9, 13h. 10m.; secondary maximum, May 9, oh. 40m.

Epoch May 12, 23h. 30m., twenty-fifth order of magnitude. Principal maximum, May 11, 16h. 15m.; secondary maxima, May 9, 19h. 30m., and May 12, 5h.

Epoch May 13, 10h., approximately twenty-fifth order of magnitude. Principal maximum, May 13, 15h. 55m., May 14, 23h. 25m., and May 16, 11h. 45m.

Epoch May 19, 6h., fifteenth order of magnitude. Principal maximum, May 18, 17h.; secondary maximum, May 18, 9h. 55m.

Epoch May 19, 18h., fourteenth order of magnitude. Principal maximum, May 18, 5h. 30m.; secondary maxima, May 19, 13h. 55m. and 16h. 5m.

Epoch May 19, 18h., thirteenth order of magnitude. Principal maxima, May 19, 20h. 55m., and May 21, 16h. 55m.; secondary maxima, May 21, 5h. 45m. and 12h. 50m.

Epoch May 21, 22h., second order of magnitude. Principal maximum, May 23, 13h. 45m.; secondary maxima, May 22, 10h. 30m., and May 23, 7h. 30m.

The intensity of an epoch being inversely as its order of magnitude, the greatest meteoric activity occurs on May 4 and May 23. The epoch of May 21, 22h., apart from its high intensity, is a very interesting epoch, and this remark applies also to the double epoch of May 19, 18h.

April 29.

JOHN R. HENRY.